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भाग 2 कार्यकारिता अपेक्षाएं

Indian Standard

ac SUPPLIED ELECTRONIC BALLASTS FOR TUBULAR FLUORESCENT LAMPS — SPECIFICATION

PART 2 PERFORMANCE REQUIREMENTS

(First Reprint NOVEMBER 1992)

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Electric Lamps and Their Auxiliaries Sectional Committee, ETD 23

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FOREWORD

This Indian Standard (Part 2) was adopted by the Bureau of Indian Standards, after the draft finalized by the Electric Lamps and their Auxiliaries Sectional Committee had been approved by the Electrotechnical Division Council.

In the preparation of this standard, assistance has been taken from the following:

IEC Doc : 34 C (Central Office) 173 'ac supplied electronic ballasts for tubular fluorescent lamps; Performance Requirements'; and

IEC Pub 555-2 : (1982) 'Disturbances in supply system caused by household and similar electrical equipment, Part 2 : Harmonics', issued by the International Electrotechnical Commission (IEC).

Part 1 of this standard deals with general requirements of ac supplied electronic ballasts for tubular fluorescent lamp.

Indian Standard

ac SUPPLIED ELECTRONIC BALLASTS FOR TUBULAR FLUORESCENT LAMPS — SPECIFICATION

PART 2 PERFORMANCE REQUIREMENTS

1 SCOPE

1.1 This standard (Part 2) specifies performance requirements for electronic ballasts for use on ac supplies up to 1 000 V at 50 Hz with operating frequencies deviating from the supply frequency, associated with tubular fluorescent lamps as specified in IS 2418 (Parts 1 and 2) : 1977 Tubular fluorescent lamps for general lighting services Part 1 Requirements and tests (*first revision*) Part 2 Standard lamp data sheets (*first revision*) for high frequency operation.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
2418 (Part 1) : 1977	Tubular fluorescent lamps for general lighting service: Part 1 Requirements and tests (*first revision*)
2418 (Part 2) : 1977	Tubular fluorescent lamps for general lighting service: Part 2 Standard lamp data sheets (*first revision*)

3 DEFINITIONS

3.0 For the purpose of this standard, the following definitions shall apply.

3.1 Starting aid

A starting aid may be either a conductive strips affixed to the outer surface of a lamp, or a conductive plate which is spaced within an appropriate distance from a lamp.

3.1.1 A starting aid may only be effective when it has an adequate potential difference from one of the lamp.

3.2 Ballast Lumen Factor

The ratio of the light output of the lamp when the ballast under test is operated at its rated voltage, compared with the light output of the same lamp operated with the appropriate reference ballast supplied at its rated voltage and frequency.

3.3 Reference Ballast

A special ballast designed for the purposes of providing comparison standards for testing ballasts and for selecting reference lamps. It is essentially characterized by the fact that at its rated frequency, it has a stable voltage/current ratio which is relatively uninfluenced by variations in current, temperature and the magnetic surroundings, as outlined in this standard.

3.4 Reference Lamp

A lamp selected for testing ballasts which, when associated with a reference ballast under specified conditions, has electrical characteristics which are close to the nominal values as stated in the relevant lamp standard for that particular type of lamp.

3.5 Calibration Current of a Reference Ballast

The value of the current on which are based the calibration and control of the ballast.

3.6 Total Circuit Power

The total power consumed by ballast and lamp in combination, at rated voltage and frequency of the ballast.

3.7 Circuit Power Factor : Symbol λ

The power factor of the combination of a ballast and the lamp or lamps for which the ballast is designed.

3.8 High Power Factor Ballast

A ballast having a circuit power factor of at least 0 85.

NOTE — The value 0·85 takes into account the effect on the power factor of the distortion of the current waveform.

For North America, high power factor is defined as a power factor of at least 0·9.

3.9 High Audio-Frequency Impedance Ballast

A ballast of which the impedance in the frequency range 250 Hz to 2 000 Hz exceeds the values specified in **14** of this standard.

3.10 Low-Distortion Type Ballast

A ballast of which the harmonic content complies with the more severe requirements of **12.1** of this standard.

3.11 Preheat Starting

Type of circuit in which the lamp electrodes are brought to emission temperature before the lamp actually ignites.

3.12 Non-preheat Starting

Type of circuit which utilizes a high open-circuit voltage causing field emission from electrodes.

3.13 Pre-start Time

For ballasts according to **3.12** the period after switching on the supply voltage during which the lamp current is $<$ 10 mA.

4 GENERAL NOTES ON TESTS

4.1 The tests are carried out in the order of clauses, unless otherwise specified.

4.2 For carrying out type test, one specimen is submitted to all tests.

4.3 In general, all tests are made on each type of ballast or, where a range of similar ballast is involved, for each rated wattage are in the range or on a representative selection from the range as agreed with the manufacturer.

4.4 The tests are made under the conditions specified in Annex A.

4.4.1 Lamp data sheets not published in an Indian Standard shall be made available by the lamp manufacturer.

4.5 All ballasts specified in this standard shall comply with the requirements of Part 1 of this standard.

5 MARKING

5.1 Ballasts shall be clearly marked with the following mandatory markings:

a) Circuit power factor, for example, 0·85.

If the power factor is less than 0·95 leading, it shall be followed by the letter 'C', for example, 0·85 C.

The following marking shall be added, if appropriate:

i) The symbol Z which indicates that the ballast is designed to comply with the conditions for audio-frequency impedance; and

ii) The symbol $\boldsymbol{H}$ which indicates that the ballast is not of the low distortion type.

5.2 In addition to the above mentioned mandatory marking, the following information shall be given either on the ballast or be made available in the manufacturer's catalogue or the like (*see* also Annex B).

a) A clear indication regarding the type of starting, namely, preheat of non-preheat;

b) Indication whether a ballast needs a starting aid; and

c) Ballast lumen factor and total circuit power in combination.

5.3 Non-mandatory information which may be made available by the manufacturer.

a) Rated output frequency at rated voltage, with and without lamp operating; and

b) Limits of the ambient temperature range within which the ballast shall operate satisfactorily at the declared voltage (range).

5.4 The ballasts may also be marked with BIS Standard Mark.

6 GENERAL STATEMENT

6.1 It may be expected that ballast complying with this standard, when associated with lamps which comply for high-frequency operation, shall provide satisfactory starting of the lamp at an air temperature immediately around the lamp between 10°C and 35°C and operation between 10°C and 50°C at voltages within 92 percent and 106 percent of the rated voltage.

NOTE — The nominal electrical characteristics as given on the lamp data sheets of IS 2418 (Part 2) : 1977 and applying to operation on a reference ballast at rated voltage with a frequency of 50 Hz may deviate when operating on a high frequency ballast and the conditions of **5.3** (b) above.

7 STARTING CONDITIONS

7.0 Ballasts shall start lamps, without adversely affecting the performance of the lamp when operated according to intended use. An explanation of the starting conditions is given in Annex D.

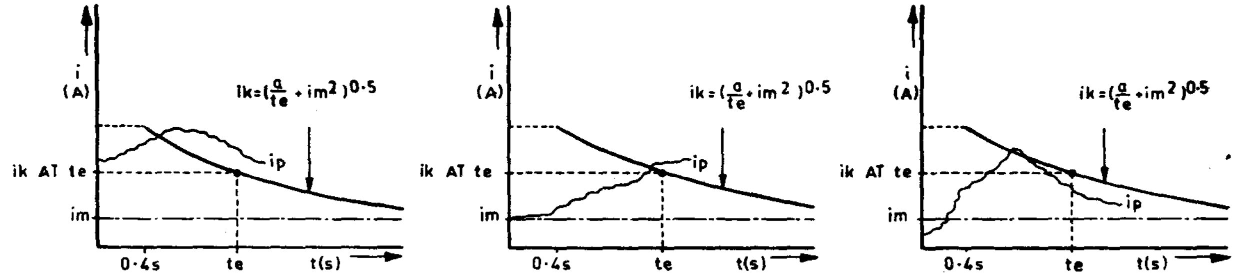
Compliance is checked by the tests according to **7.1** to **7.4**, as appropriate, with the ballast operating at any supply voltage between 92 percent and 106 percent of its rated value.

7.1 Ballast for Current-Controlled Preheat Starting Mode

For ballasts of this category, the following requirements apply:

The test is carried out in accordance with the requirement of **A-4** of Annex A.

7.1.1 With a non-inductive substitution resistor of the value specified on the relevant lamp data sheet, substituted for each lamp electrode, the ballast shall deliver a minimum total effective heating current according to the time/current limits specified on the relevant lamp data sheets (*see* Fig. 1).



Example 1 Example 2 Example 3

The total heating effect of the varying heating current to time t_e shall not be less than the equivalent of the steady state rms current i_k (at t_e) for the same heating effect.

Possible instances are shown in the three examples:

Example 1 Ballast complies with sub-clause **7.1.1.** Varying rms current i_p never falls below steady state rms currrent i_k (at t_e), therefore, the rms envelope of current i_p can be used to show $\int_0^{t_e} i_p^2\,dt > \int_0^{t_e} i_k^2\,dt$.

Example 2 Ballast does not comply with sub-clause **7.1.1.** Varying rms current i_p only reaches the level of steady state rms current i_k (at t_e) just before time t_e, therefore, the rms envelope of current i_p can be used to show $\int_0^{t_e} i_p^2\,dt < \int_0^{t_e} i_k^2\,dt$.

Example 3 Ballast may or may not comply with sub-clause **7.1.1.** The varying rms current i_p only exceeds the steady state rms current i_k for part of the time period to t_e. Energy measurements or calculation are necessary to determine whether $\int_0^{t_e} i_p^2\,dt > \int_0^{t_e} i_k^2\,dt$.

FIG. 1 INTERPRETATION OF EFFECTIVE HEATING CURRENT

7.1.1.1 The absolute minimum preheat time shall be at least 0·4 s unless otherwise specified on the relevant lamp data sheet.

7.1.1.2 The maximum effective heating current shall not exceed the limits specified on the relevant lamp data sheet at any time *t*.

7.1.2 The open circuit voltage across any pairs of substitution resistors representing a lamp shall not exceed the maximum values specified on the lamp data sheets, during the preheat period. After the preheating period it shall be, or rise to a value, not less than the minimum value for lamp starting, as specified on the lamp data sheet.

7.1.2.1 If the current through the substitution resistor, as specified in **7.1.1**, is interrupted before the minimum specified voltage for lamp starting has been reached, the voltage rise to minimum starting voltage shall take place within not more than 0·1 s (*see* Fig. 2A)

7.1.2.2 If the voltage rise takes more than 0·1 s, the current through the substitution resistor shall not fall below the absolute minimum value specified (*see* Fig. 2B).

7.1.2.3 The crest factor of the open circuit voltage shall not exceed 1·8. Even very narrow voltage peaks which do not influence the rms value shall not occur during the minimum preheat period.

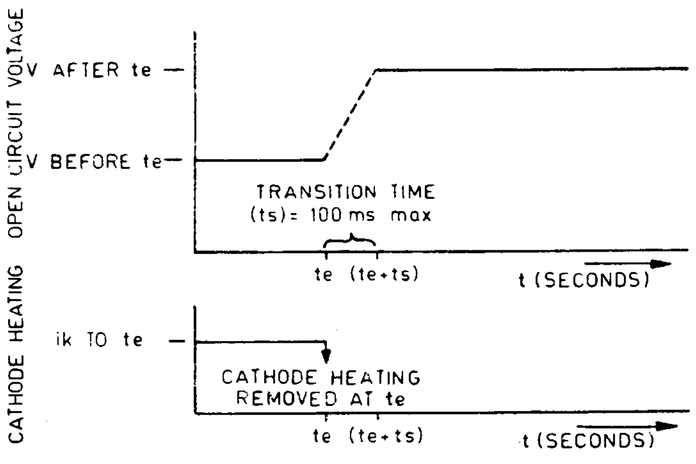
7.2 Ballasts for Voltage-Controlled Preheat Starting Mode

Ballasts of this type shall provide proper cathode preheating voltage, cathode operating voltage, and lamp starting voltages. Limiting values and appropriate substitution resistors are specified on the relevant lamp data sheets in IS 2418 (Part 2) : 1977.

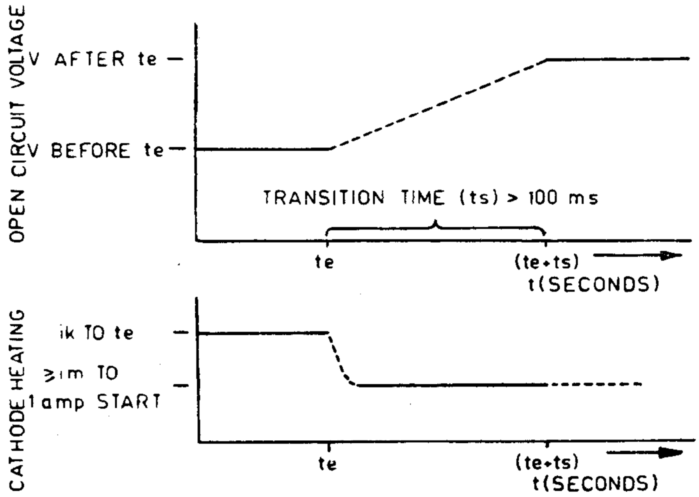
Lamps with either low resistance cathodes or high resistance cathodes may be operated by this method.

7.2.1 Ballasts shall deliver rms cathode heating voltage, within the limits specified on the relevant lamp data sheet, to the specified substitution resistors, when rated supply voltage is applied.

7.2.1.1 It is permitted to exceed the maximum cathode voltage limit provided the maximum cathode current is in accordance with the requirements for current controlled preheating.



2A Ballasts, which remove preheating current when D-2.1 open circuit voltages are elevated.



2B Ballasts, which have open circuit voltage transition times >100 ms.

FIG. 2 OPEN CIRCUIT VOLTAGE REQUIREMENTS FOR BALLASTS WITH CURRENT CONTROLLED PREHEATING

7.2.1.2 The minimum application time of the cathode heating voltage shall be 0·4 s.

7.2.1.3 Depending upon lamp data sheet requirements, the cathode heating voltage after 0·4 s may be:

a) Applied continuously during operation;

b) Reduced to a lower level; and

c) Reduced to 0.

7.2.2 Ballasts shall provide the lamp starting voltages specified on the relevant lamp data sheet for:

a) rms voltage across the lamp; and

b) Peak voltage to starting aid, if required.

7.2.2.1 Starting requirements for various series circuits may be specified. For operation of lamp in parallel circuits, the relevant single lamp requirement shall be provided for each lamp.

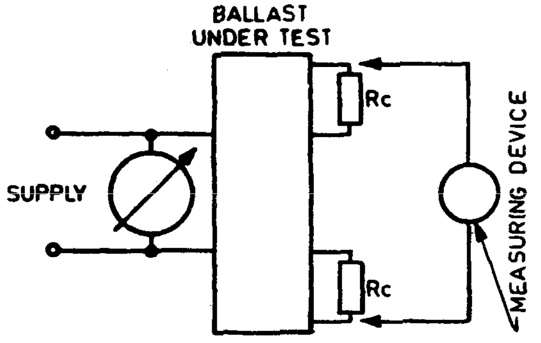
7.2.2.2 The starting voltages may be available simultaneously with the cathode preheating voltage or they may be elevated to those levels after 0·4 s elapsed time. Any voltage applied before 0·4 s shall be lower than the level that would cause starting of the lamp or shall be in accordance with the values given for current controlled preheating.

7.3 Ballast for Non-preheat Starting Mode

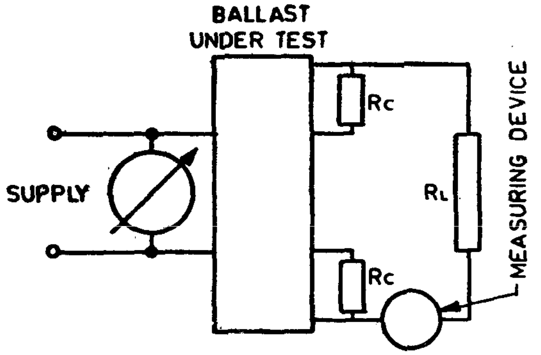
Ballasts in accordance with definition **3.12** shall be so designed that the cumulative glow discharge periods during starting do not exceed 100 ms when measured with a reference lamp and without any earthed metal parts close by which might act as starting aid. The flow discharge period is deemed to have finished if the lamp current is at least 80 percent of the nominal lamp current.

Measurement is made with an oscilloscope (*see* Fig. 3).

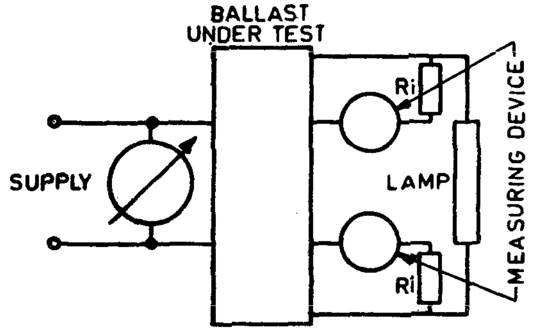
A ballast is deemed to conform with the requirements when the following conditions are fulfilled.



3A Test circuit for open-circuit voltage



3B Test circuit for ballast impedance



3C Test circuit for cathode current

FIG. 3 TEST CIRCUIT FOR NON-PREHEAT STARTING MODE

7.3.1 *Open Circuit Voltage*

The open circuit voltage shall comply with the value as specified on the relevant lamp data sheet.

NOTE — In case of additional cathode heating during the starting process, lower values may be sufficient provided the glow discharge period does not exceed 100 ms.

7.3.2 *Ballast Impedance Test*

With a non-inductive substitution resistor of the value on the relevant lamp data sheet substituted for the lamp, and at 92 percent of the rated voltage, the ballast shall deliver a current not less than the minimum value specified on that data sheet.

7.3.3 *Cathode Current*

Ballasts of the non-preheat start type may supply some cathode heating during the starting.

7.3.3.1 The cathode current, if any, shall not exceed the maximum value as specified on the relevant lamp data sheet. The measurement is carried out with a substitution resistor the value of which shall be calculated as follows:

$$R_0 = 11 (2{\cdot}1 \, I_n)^{-1}$$

where

I_n = Nominal value of the lamp operating current.

7.4 Starting Aid and Distances

Lamps operated with electronic ballasts complying with this standard may require a starting aid as IS 2418 (Part 2) : 1977.

7.4.1 The open circuit voltage and voltage to starting aid (if required), during preheat and starting, shall be within the limits specified in the information for ballast design on the relevant lamp data sheet.

8 OPERATING CONDITIONS

8.1 At rated voltage, the ballast lumen factor shall be not less than 95 percent of the value declared by the manufacturer.

8.1.1 If the declared lumen factor of the ballast is less than 0·9, evidence shall be given that the performance of lamps operated on that ballast is not impaired. A relevant test is under consideration.

8.2 At rated voltage, the total circuit power shall be not more than 110 percent of the value declared by the manufacturer, when the ballast is operated with a reference lamp.

8.3 Requirements for dimming are under consideration. Provisionally, when operating lamps of lower lumen levels than the optimum design points care shall be taken that the ballast provides cathode heating continuously to the lamp(s) so that lamp life is not degraded.

8.3.1 The requirements for maximum current in any lead to a cathode should be observed.

9 CIRCUIT POWER FACTOR

9.1 The measured circuit power factor shall not differ from the marked value by more than 0·05 when the ballast is operated with one or more reference lamp(s) and the whole combination is supplied at its rated voltage and frequency.

10 SUPPLY CURRENT

10.1 At rated voltage, the supply current shall not differ by more than ±10 percent from the value marked on the ballast or declared in the manufacturer's literature, when the ballast is operated with a reference lamp.

11 MAXIMUM CURRENT IN ANY LEAD TO A CATHODE

11.1 In normal operation at any supply voltage between 92 percent and 106 percent of the rated value, the current flowing in any one of the cathode terminations shall not exceed the value given on the relevant lamp data sheet.

11.2 The measurment is made with an oscilloscope or another suitable device. The measurements shall be made with a reference lamp at all contact to the cathodes.

12 CURRENT WAVEFORM

12.1 Supply Current Waveform

The requirements and limits specified in this clause are applicable to electronic ballast intended to be connected to ac supplies up to and including 1 100 volts at 50 Hz.

The harmonics of the input current for self-ballasted lamps, semi-luminaires and luminaires measured shall not exceed the limits given in Table 1 with the following exceptions.

Table 1 Limits of Harmonics Current

(*Clauses* 12.1, 12.1.1, 12.1.4 *and* 12.1.5)

Harmonic Order n	Maximum Value Expressed as a % of the Fundamental Current of the Luminaire
2	5
3	30 λ*
5	7
7	4
9	3
11 < n < 39†	2

*λ is the circuit power factor.

†For luminaires having a non-electronic ballast, the harmonics of these orders need not be checked.

12.1.1 If separate tests with reference lamps have proved that ballasts for fluorescent lamps comply with the requirements as given in Table 1, the luminaire is deemed to comply with these requirements and need not be checked. Manufacturers should indicate whether or not the ballast under test should be subjected to the following test.

12.1.2 Where these components have not been approved separately or do not comply, the luminaire itself shall be tested and shall comply.

12.1.3 The test is carried out in accordance with the requirements of **A-2** of Annex **A**.

12.1.4 For luminaires, where the ballasts of the H-mark category are permitted, the harmonics shall not exceed the limits specified in Table 1 or Table 2, as appropriate.

Table 2 Limits of Harmonics Current

Harmonic Order n	Maximum Value Expressed as a % of the Fundamental Current of the Luminaire
2	5
3	37 λ*
> 5	Not limited

*λ is the circuit power factor.

12.1.5 The ballast shall be operated at its rated voltage with a reference lamp or lamps. After lamp stabilization, the waveform of the supply current shall be such that the harmonic shall not exceed the limits given in Table 1.

12.2 Lamp Operating Current Waveform

The test is carried out in accordance with the requirements of **A-2** of Annex A.

12.2.1 The ballast shall be operated with a reference lamp or lamps at its rated voltage. After lamp stabilization, the waveform of the lamp current shall comply with the following conditions:

a) In every successive half-cycle, the enveloping wave of the lamp current shall not differ by more than 4 percent at the same time after phase zero passage of the mains supply voltage.

NOTE — The purpose of this requirement is to avoid the inconsistency of the wave shape of the enveloping wave from half mains cycle to half mains cycle; and

b) The maximum ratio of peak value to rms value shall not exceed 9·7 individual high-frequency crest factor.

12.2.2 In the case where the high-frequency is modulated at mains frequency, the maximum lamp current crest factor for the modulated envelope should not exceed 1·7.

NOTE — High frequency current crest factor is equal to peak current of the modulated or unmodulated envelope divided by the effective rms current.

13 MAGNETIC SCREENING

13.1 Ballasts shall be effectively screened against magnetic influence of adjacent ferromagnetic materials.

13.2 Compliance is checked by the following test:

The ballast is operated at rated voltage with an appropriate lamp. After stabilization, a steel plate 1 mm thick and of length and breadth greater than those of the ballast under test is successively placed in direct contact with the bottom plate of the ballast and at a distance of 1 mm from each face of the latter. During this operation, the lamp current is measured and this shall not change by more than 2 percent due to the presence of the steel plate.

14 IMPEDANCE OF AUDIO-FREQUENCIES

14.1 Ballasts marked with the audio-frequency symbol (*see* **5.1**) is tested using one of the circuits shown in **A-3** of Annex A.

14.2 For every signal frequency between 400 Hz and 2 000 Hz, and with a signal voltage equal to 3·5 percent of the rated supply voltage of the ballast, the impedance of the ballast, when operated with a reference lamp supplied at its rated voltage and frequency, shall be inductive and at least equal to value to the resistance which would dissipate the same power as the lamp/ballast combination in question when it is supplied at its rated voltage and frequency.

14.3 Between 250 Hz and 400 Hz, the impedance shall be at least equal to half the minimum value required for frequencies between 400 Hz and 2 000 Hz.

NOTE — Radio interference suppressors consisting of capacitors of less than 0·2 μF (total value) which may be incorporated in the ballast may be disconnected for this test.

15 MAINS TRANSIENT OVERVOLTAGE

15.1 Mains transients of either polarity, randomly phased and superimposed on the mains voltage, as specified below, shall not disturb the intended functioning of the equipment or lead to damage. Direct influence of lighting on the mains distribution has not been taken into account.

Amplitude	*Rise Time*	*Pulse Width*	*Source Impedance*	*Reception Rate*	*Energy Max*
Slow high energy					
Asymmetric 3 000 V	300 ns	50μs	45 Ω	160 ms (1/8 mains* frequency)	2 J
Symmetric 1 000 V	500 ns	50μs	5 Ω	160 ms (1/8 mains* frequency)	2 J
Fast low energy					
Asymmetric 2 500 V	5 ns	100 ns	50 Ω	1/5 mains frequency	2 mJ

*Minimum pulse repetition rate 1/10 Hz.

15.2 The test is carried out in accordance with the requirements of **A-5** of Annex A.

15.3 Voltages apply to the unloaded generator.

15.4 Pulses to be applied in symmetrical, differential or series mode (that is, from phase to neutral or from phase to phase) and in asymmetrical or common mode (that is, from phase and neutral or phase to system ground and/or protective earth).

16 OPERATIONAL TESTS FOR ABNORMAL CONDITIONS

16.1 Removal of Lamp(s)

During operation of the ballast at rated voltage +10 percent and in association with the appropriate lamp(s), the lamp(s) is(are) disconnected for 1 h from the ballast without switching off the supply voltage. At the end of this period the lamp(s) is(are) reconnected and shall start and operate normally at least after line re-switch on.

16.2 Lamp Fails to Start

With an appropriate dummy cathode resistor specified on the relevant data sheet connected in place of each lamp cathode, the ballast shall be operated at rated voltage +10 percent for 1 h. At the end of this period, the resistor is removed and the appropriate lamp(s) is(are) connected and shall start and operate normally at least after line re-switch on.

17 ENDURANCE

17.1 Before the test, the ballast shall be subjected to a temperature cycling and open-circuit switching test, as follows:

a) The ballast shall be stored first at the lower limit of the ambient temperature for 1 h. The temperature is then raised to t_c for 1 h. Five such temperature cycles shall be carried out; and

b) At rated supply voltage, the ballast shall be switched on and off each for 30 s. This cycle shall be repeated 1 000 times with the output terminals open.

17.2 The ballast shall than be operated with an appropriate lamp at rated supply voltage and at the ambient temperature which produce t_0, until a test period of 200 h has passed. At the end of this time, and after cooling down to room temperature, the ballast shall start and operate correctly an appropriate lamp for 15 min.

17.2.1 During this test, the lamps are placed outside the test enclosure at an ambient temperature of 25°C ± 5°C.

ANNEX A

(*Clauses* 4.4, 7.1, 12.1.3, 12.2, 14.1 *and* 15.2)

METHODS OF TESTS

A-1 GENERAL REQUIREMENTS

Tests according to this standard are type tests. One sample shall be submitted to all tests.

NOTE — The requirements and tolerances permitted by this standard are related to testing of a type test sample submitted for that purpose. In principle this type test sample should consist of units having characteristics typical of the manufacturers production and be as close to the production centre point as possible.

It may be expected that with the tolerances given in the standard, products manufactured in accordance with the type test sample will ensure compliance with the standard for the majority of the production. Due to the production spread, it is inevitable, however, that there may be products outside the specified tolerances. For guidance of sampling plans and procedures for inspections by attributes.

A-1.1 Ambient Temperature

Tests shall be made in a draught free room and at an ambient temperature within the range 20°C to 27°C.

A-1.1.1 For those tests which require constant lamp performance the ambient temperature around the lamp shall be within the range 23°C to 27°C and shall not vary be more than 1°C during the test.

A-1.2 Supply Voltage and Frequency

a) *Test Voltage and Frequency* — Unless otherwise specified, the ballast to be tested shall be operated at its design voltage and the reference ballast at its rated voltage and frequency.

   When a ballast is marked for use on a range of supply voltages or has different separate rated supply voltages, any voltage for which it is intended may be chosen as the rated voltage.

b) *Stability of Supply and Frequency* — For the majority of the tests, the supply voltage and, where appropriate for the reference ballasts, the frequency shall be maintained constant within ±0·5 percent. However, during the actual measurement, the voltage shall be adjusted to within ±0·2 percent of the specified testing value.

c) *Supply Voltage Waveform* — The total harmonic content of the supply voltage shall not exceed 3 percent. Harmonic contact being defined as the rms summation of the individual components using the fundamental as 100 percent.

A-1.3 Magnetic Effects

Unless otherwise specified, no magnetic object shall be allowed within 25 mm of the face of the reference ballast or the ballast under test.

A-1.4 Mounting and Connection of Reference Lamps

In order to make the reference lamps repeat their electrical values with the greatest consistency, it is recommended that the lamps be mounted horizontally and allowed to remain permanently in their test lampholders. So far as the identification of ballast terminal shall permit, reference lamps should be connected in circuit maintaining the polarity of the connections used during ageing.

A-1.5 Reference Lamp Stability

a) A lamp shall be brought to a condition of stable operation before carrying out measurements. No swirling shall be present; and
b) The characteristics of a lamp shall be checked immediately before and immediately after each series of tests in accordance with Annex C.

A-1.6 Reference Ballast

The reference ballast used shall be that indicated on the relevant lamp data sheet.

A-1.7 Instrument Characteristics

a) *Potential Circuits* — Potential circuits of instruments connected across the lamp shall not pass more than 3 percent of the nominal running current;
b) *Current Circuits* — Instruments connected to series with the lamp shall have a sufficiently low impedance such that the voltage drop shall not exceed 2 percent of the objective lamp voltage.

Where measuring instruments are inserted into parallel heating circuits, the total impedance of the instruments shall not exceed 0'5 Ω; and

c) *rms Measurements* — Instruments shall be essentially free from errors due to waveform distortion and shall be suitable for the operating frequencies. Care shall be taken to ensure that the earth capacitance of instruments does not disturb the operation of the unit under test. It may be necessary to ensure that the measuring point of the circuit under test is at earth potential.

A-2 MEASUREMENT OF THE CURRENT WAVEFORM

A-2.1 The harmonic components in the mains current shall be determined by means of a selective voltmeter or wave analyzer and the resister R introduced in the circuit shall be in accordance with A-**1.7**.

A-2.2 The selective voltmeter or wave analyzer should ensure that measurements being made on any given harmonic are not significantly affected by other harmonics.

A-2.3 The supply voltage distortion of maximum 3 percent (*see* **A-1.2**), shall be taken into account when evaluating the test results, in case of doubt a distortion-free supply shall be used.

A-2.4 The peak value of lamp current shall be determined by means of a calibrated oscilloscope (*see* Fig. 4).

A-3 MEASUREMENT OF IMPEDANCE AT AUDIO-FREQUENCIES

A-3.1 The circuit in Fig. 5 illustrates a bridge for the determination of the audio-frequency impedance Z of the lamp/ballast assembly.

A-3.2 Let R' and R'' represent the values of the resistors shown in the circuit diagram by the values of 5 Ω and 200 000 Ω respectively (the latter at least not being critical). When by adjustments of R and C, a balance is obtained for a given audio-frequeney selected on the wave analyzer (or any other suitable selective director) we have, in general:

$$Z = R' R'' \left(\frac{1}{R} + jwC \right)$$

If the resistors R' and R'' have precisely the indicated values, the equation becomes:

$$Z = 10^6 \left(\frac{1}{R} + jwC \right)$$

where :

A = Supply transformer 50 Hz to 60 Hz (*see* Fig. 5);

B = Lamp-ballast assembly under test (*see* Fig. 5);

Z_1 = Impedance of value sufficiently high for 50 Hz to 60 Hz sufficiently low for 250 Hz to 2 000 Hz (for example, resistance 15 Ω + capacitance 16 μF); and

Z_2 = Impedance of value sufficiently low for 50 Hz to 60 Hz sufficiently high for 250 Hz to 2 000 (for example, inductance 20 mH).

NOTE — The impedance Z_2 and/or Z_2 are not necessary if the corresponding source has a low internal impedance for the currents of the other.

A-4 MEASUREMENT OF CURRENT CONTROLLED PREHEAT STARTING

A-4.1 Test Equipment

The test circuit shall be arranged containing the ballast under test, the electrode substitution resistors (R_0) specified on the relevant lamp data sheet and a measuring device.

A-4.2 The measuring device could be an oscilloscope provided with a voltage and/or current probe (*see* Fig. 6).

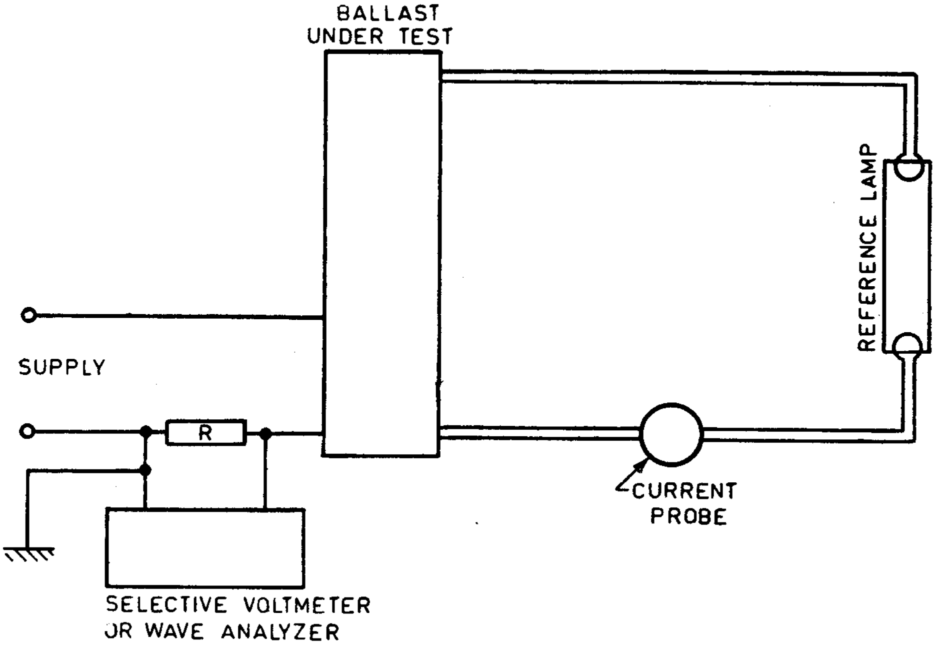
A-4.3 If a ballast is intended for operating more than one lamp, in parallel circuit electrode substitution resistors shall be connected to all relevant contacts and measurements shall be taken at each substitution resistor respectively at each pair of substitution resistor representing a lamp successively. If a ballast is intended for operating two lamps in series circuits the measurement is carried out with the lamp cathodes of both lamps being replaced by cathode substitution resistors. If applicable connect the secondary output winding of the isolating transformer is included in the ballast, then an isolating transformer shall be inserted at the input side. The total open circuit voltage is then measured across both lamps.

During preheat the open circuit voltage shall be equal or less than the specified voltage for one lamp. During ignition the open circuit voltage shall be geater than the minimum voltage specified on the lamp data sheet for two lamps in series. The voltage to the starting aid if any, shall comply with the specified voltage.

A-4.4 Measurement

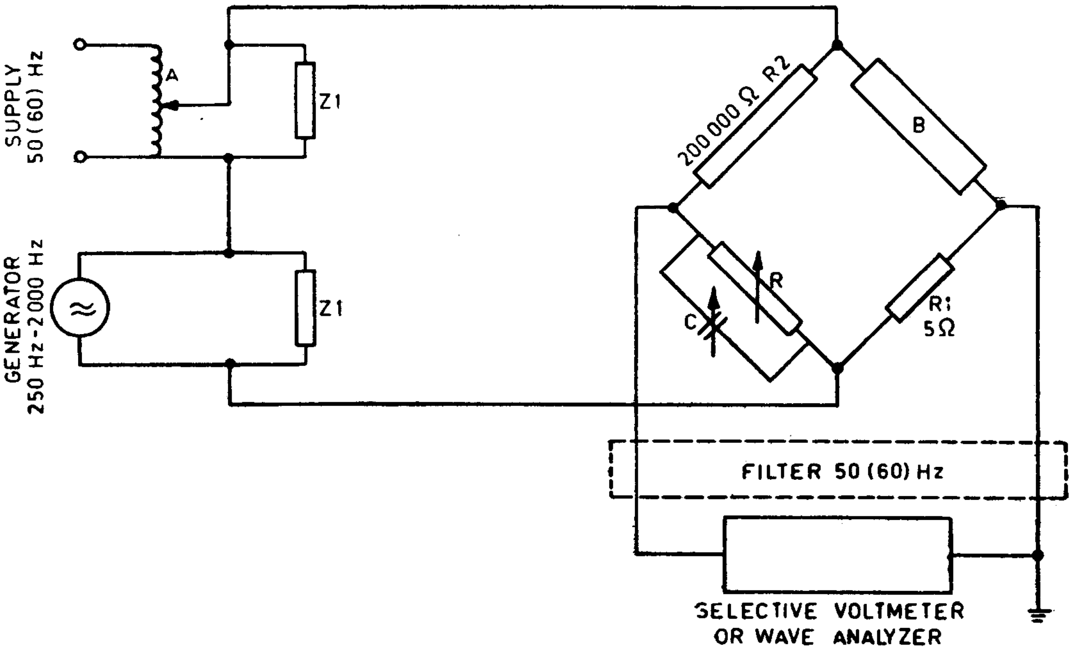
With the aid or the measuring device, the heating current and open circuit voltage are determined in relation to time.

A-4.4.1 For a steady state rms current, the effective values of the heating current is determined by observation of one single HF period from which the effective value and the crest factor is determined.



NOTE — The measuring device is connected to that output which is nearest to earth potential. Earthing of any output circuit is not necessary.

FIG. 4 MEASUREMENT OF CURRENT WAVEFORM



NOTE — The value of 200 000 Ω for one branch of the bridge is not critical.

FIG. 5 MEASUREMENT OF IMPEDANCE AT AUDIO-FREQUENCIES

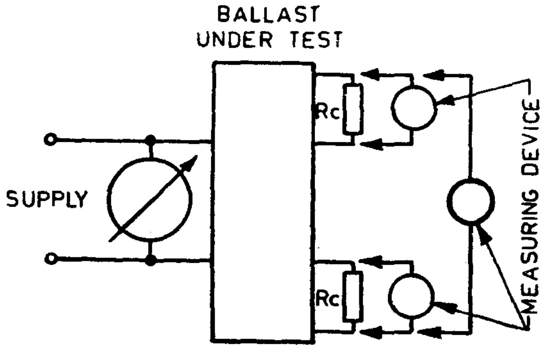


FIG. 6 TEST CIRCUIT BALLASTS FOR CURRENT-CONTROLLED PREHEAT STARTING MODE

A-4.4.2 A direct measurement of the effective value might be possible with suitable instrumentation.

A-4.4.3 For a varying current, the effective value of the heating current is defined as such value which is equivalent to a steady state rms current of the some heating effect (*see* Fig. 1).

A-4.4.4 With the aid of the formula given on the lamp data sheets, the time to emission is calculated (*see* **D-5.1.1.1**).

A-4.4.5 The determination of the effective value of the open circuit voltage is current out on analogy with the determination of the effective value of the current.

A-5 TEST TRANSIENT OVERVOLTAGES

A-5.1 An example of suitable equipment is Schaffner NSG 223 for the slow high energy pulses, NSG 222A for the fast low energy pulses, NSG 200C (for 220 V to 240 V and 50 Hz) or NSG 200D (for 110 V to 120 V and 60 Hz) (dated 1983) or equivalent equpment.

A-5.1.1 For application, consult the manuals of the test equipment.

A-5.2 Test of Slow High Energy Pulses

a) *Pulse Amplitude* — 3 000 V in the asymmetrical mode and 1 000 V in the symmetrical mode;

b) *Pulse Rise Time* — 300 ns asymmetrical mode 150 ns symmetrical mode, pulse width approximately 50 s;

c) Pulse phase position : Pulse phase is continuously changed from 80° to 460° by slowly moving the knob from one extreme phase position to the other and slowly back during 1 min;

d) *Pulse Polarity* — '+' and '—';

e) *Pulse Repetition Time* — Minimum 150 ms and maximum 10 s;

f) Equipment to be tested with most unfavourable control setting; and

g) If possible, automatic pragrammes to be assisted.

Check : On proper functions and the integrity of the components of the mains part of the equipment like the mains filter and the mains transformer.

NOTES

1 As a fast succession of high energy pulses may overload components in the mains part of the equipment, it is sometimes expedient to enlarge the pulse repetition time to at most 10 s.

2 As this test may degrade some components, for example, VDRs used as mains transients suppressors and triacs. the test report shall state the repetition time used and the number of pulses actually applied. The components of which is known that they are affected by this test shall be replaced.

A-5.3 Test of Fast Low Energy Pulse

a) *Pulse Amplitude* — 2 500 V in the asymmetrical mode;

b) *Pulse Rise Time* — 5 ns, pulse width approximately 100 ns;

c) *Pulse Phase Position* — Pulse phase is continuously changed from 80° to 460° by slowly moving the knob from one extreme phase position to the other and slowly back during 1 min;

d) *Pulse Polarity* — '+' and '—'; and

e) *Pulse Repetition Frequency* — Approximately 1/5 mains frequency.

Check : On proper functioning and the integrity of the components of the mains part of the equipment like the mains filter and the mains transformer.

ANNEX B

(*Clause* 5.2)

REFERENCE BALLASTS

B-1 MARKING

B-1.1 The reference ballast shall be provided with durable and legible marking as follows:

a) The words 'reference ballast' or 'HF reference ballast', as applicable in full;

b) Identification of the responsible vendor;

c) Serial number;

d) Rate lamp wattage and calibration current; and

e) Rated supply voltage and frequency.

B-2 DESIGN CHARACTERISTICS

B-2.1 General Design for Frequencies of 50 Hz to 60 Hz

A reference ballast is a self-inductive coil, with or without an additional resistor, designed to give the operating characteristics of **B-3**.

B-2.1.1 It may be used either in a circuit employing a starter or, where applicable, in a circuit including separate power sources to heat the lamp cathode.

B-2.2 HF Reference Ballast for Frequencies of 25 kHz

An HF reference ballast is a resistor designed to give the operating characteristics of **B-4**.

B-2.2.1 Since the type of HF reference ballast is intended to serve as a permanent baseline of reference, it is vitally important that the ballast be so constructed as to provide permanence of resistance under normal conditions of use. For this purpose, it may be provided with suitable means of resorting the reference resistance.

B-2.2.2 A HF reference ballast shall be enclosed in a case for mechanical and electrical protection. Care should, however, be taken for proper conduction of the dissipated wattage losses.

B-2.3 Protection

The ballast shall be protected, for example, by means of a suitable steel case, against magnetic influence in such a way that its ratio of voltage to current for the calibration current shall not be changed by more than 0·2 percent when a 12·5 mm thick plate of ordinary mild steel is placed at 25 mm from any face of the ballast enclosure.

B-2.3.1 Moreover, the ballast shall be protected against mechanical damage.

B-3 OPERATINC CHARACTERISTICS FOR FREQUENCIES OF 50 Hz

B-3.1 Rated Supply Voltage and Frequency

The rated supply voltage and frequency of a reference ballast shall be in accordancc with the values given in IS 2418 (Part 2) : 1977, on the relevant lamp data sheet.

B-3.2 Ratio of Voltage to Current

The ratio of voltage to current of a reference ballast shall have the value given in IS 2418 (Part 2) : 1977, on the relevant lamp data sheet subject to the following tolerances:

a) ±0·5 percent at the calibration current value; and

b) ±3 percent at any other value of current from 50 percent to 115 percent of the calibrating current.

B-3.3 Power Factor

The power factor of the reference ballast determined at the calibration current shall be as shown in IS 2418 (Part 2) : 1977, on the relevant lamp data sheet, subject to tolerance of ±0·005.

B-3.4 Temperature-Rise

When the reference ballast is operated in an ambient air temperature of between 20°C and 27°C, calibration current at rated frequency, and after thermal stabilization, the temperature-rise of the ballast winding shall not exceed 25°C, when measured by the 'change in resistance' method.

B-4 OPERATING CHARACTERISTICS FOR FREQUENCIES OF 25 kHz

B-4.1 General

The following specifications apply to measurements made at rated input voltage and rated frequency of the HF reference ballast and with a room temperature of 25°C ± 5°C and with stabilized temperature of the reference ballast.

B-4.2 Impedance

The impedance of a HF reference ballast shall have the value given on the relevant lamp data sheet in IS 2418 (Part 2) : 1977, subject to the following tolerances:

a) ±0·5 percent at the calibration current value; and

b) 1 percent at any other value of current from 50 percent to 115 percent of the calibration current.

B-4.3 Series Inductance and Parallel Capacitance

The series inductance of the reference resistor shall be less than 0·1 mH and its parallel capacitance shall be less than 1 nF.

B-5 CIRCUIT FOR FREQUENCIES OF 25 kHz (*see* Fig. 7)

B-5.1 Cathode Heating

HF reference ballast may be used in a circuit employing separate power sources to heat the lamp cathodes for proper starting of the lamp.

B-5.1.1 These power sources shall be disconnected when measuring a lamp.

B-5.2 Power Supply

The HF voltage supply used for the adjustment of or test with the HF reference ballast shall be such that at full load the rms summation of the harmonic contents shall not exceed 3 percent of the fundamental component.

B-5.2.1 It shall be as steady and free from sudden charges as possible. For test results, the voltage should be regulated to within 0·2 percent. The frequency shall be within 2 percent.

B-5.3 Instruments

All instruments used in HF reference ballast measurements should be suitable for high frequency operation. Details are under consideration.

B-5.4 Wiring

Connecting cables shall be as short and as straight as possible to avoid parasitic capacitance.

B-5.4.1 The parasitic capacitance parallel to the lamp shall be less than 1 nF.

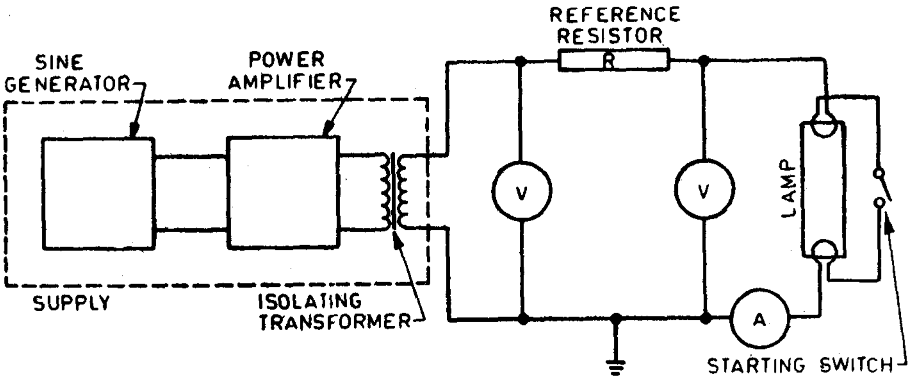


FIG. 7 HF REFERENCE CIRCUIT

ANNEX C

(*Clause* A-1.5)

REFERENCE LAMPS

C-1 A lamp which has been aged for at least 100 h is considered to be a reference lamp if when associated with a reference ballast under the conditions as defined in Annex A and operating in an ambient temperature of 25°C, the lamp wattage, voltage at lamp terminals or lamp running current do not deviate by more than 2·5 percent from the corresponding objective or nominal values, as appropriate, given in IS 2418 (Part 2) : 1977.

C-2 For lamps operated without starter, it is also required that the resistance of the cathodes shall not differ from the objective values for the type of lamp by more than 10 percent. If the resistance is higher, it may be reduced by using a shunt resistor.

C-3 A reference lamp of a type suitable for the ballast under test shall always be used.

C-4 The waveform of the current passed by a stabilized reference lamp associated with a reference ballast shall show substantially the same waveform in successive half-cycles.

NOTE — This limits the possible generation of even harmonics by any rectifying effect.

ANNEX D

(*Clause* 7.0)

EXPLANATION OF STARTING CONDITIONS

D-1 INTRODUCTION

D-1.1 The requirements for starting conditions given in **7** and the associated data given in lamp data sheets in corresponding Indian Standards have been specified to encompass the different lamp starting methods which may be employed by electronic ballasts.

D-1.2 As these starting methods may be more complex than those of conventional 50 Hz to 60 Hz circuits, this Annex is provided to assist the interpretation of the requirements of this publication and of the data specified on lamp data sheets.

D-2 CHARACTERISTICS WHICH AFFECT LAMP STARTING

D-2.0 There are five main physical characteristics which influence the starting mechanism of a fluorescent lamp:

D-2.1 Cathode Heating

Preheat current and time of application.

D-2.2 Open Circuit Voltage

Voltage across lamp and to starting aid both during preheating and at the moment of lamp ignition.

D-2.3 Environmental Conditions

Ambient temperature, relative humidity.

D-2.4 Lamp Physical Conditions

Type of filling gas and its pressure, lamp dimensions, the inclusion of an internal conducting film.

D-2.5 Supply and Luminaire Conditions

Operating frequency, starting aid dimensions and spacing.

All of these characteristics interact with each other in a complex manner and if the current combination is not obtained for a chosen method of starting, poor lamp performance may result (for example, reduced lamp life, reduced number of starting cycles for a given lamp life, excessive end blackening of the lamp).

D-3 PRINCIPAL METHODS OF LAMP STARTING

D-3.1 Traditionally, there have been two principal methods of starting fluorescent lamp associated with 50 Hz to 60 Hz ballasts, preheated cathode starting and non-preheated cathode starting.

D-3.2 Both of these methods may be used with electronic ballasts, but due to the higher technological feature that may be built into electronic ballasts revised methods of specifying, measuring and assessing the starting characteristics often have to be adopted.

D-3.3 Although electronic ballasts may produce lamp starting conditions in a more complex way than coventional 50 Hz to 60 Hz ballasts, the same principles still apply if good lamp performance is to be obtained.

D-4 PARTICULAR METHODS OF LAMP STARTING

D-4.1 Preheat Starting

Two basic methods of providing preheat cathode lamp starting are normally used, these being either:

a) Cathode current control of preheating, or
b) Cathode voltage control of preheating.

D-4.2 With both of these methods, the following requirements shall be satisfied during the starting period if satisfactory lamp performance is to be obtained:

a) Prior to cathodes reaching emission, open circuit voltages across the lamp and/or from lamp to starting aid shall be kept below the level which causes cathode damaging lamp glow currents;
b) After cathodes have reached emission, open circuit voltages shall be adequate to start the lamp quickly and without repeated starting attempts;
c) If open circuit voltages have to be elevated to achieve lamp starting, once cathodes have reached emission, the transition from low to high open circuit voltage shall occur while the cathodes are still at emission temperature; and
d) During the cathode preheating period, the heating current or voltage shall not be so excessive that the emissive material on the cathodes is damaged by overheating.

D-4.3 As the required open circuit voltages for preheat starting are relatively low, multi-lamp series circuits may be utilized for some type of lamps.

D-4.4 In such a scheme, starting capacitor(s) are sometimes employed to shunt part of the combination of lamps while full open circuit voltage is applied to the unshunted lamp. The size of the starting capacitor relates to the potentially troublesome glow current during the initial phase of starting. Attention must be paid to balance starting capacitor size with ease of starting and other lamp and ballast performance attributes.

D-4.5 Non-preheat Starting

This method of lamp starting takes advantage of the field emission that occurs at the unheated cathodes of a lamp when a high open circuit voltage is instantaneously applied across the lamp.

D-4.6 The level of open circuit voltage and the source impedance of the ballast determines the time, it takes for the lamp to pass through the glow current stage of the discharge to the full arc state.

D-4.7 One of the major reasons for excessive lamp and blackening and subsequent early lamp failure is due to unduly high and/or long lasting glow discharge current during the starting process. To minimise the damaging effects of the glow discharge current, it is necessary to ensure that a minimum value of open circuit voltage is provided and that the ballast has the ability to 'drive' the lamp rapidly through this phase without making repeated attempts at lamp starting which extend for greater than 100 ms.

D-4.8 Some ballasts may make use of currents in the lamp cathodes for purpose other than adequate cathode heating (for example, for supporting starting with reduced starting voltages). In these instances, the limitations on maximum cathode current shall be observed to avoid cathode over heating.

D-5 INTERPRETATION OF THE REQUIREMENTS OF 6 AND THE INFORMATION GIVEN ON LAMP DATA SHEETS

D-5.1 Preheat Starting

D-5.1.1 *Ballasts Using Current Controlled Preheating*

D-5.1.1.1 *Effective heating current and emission time* (t_e)

The amount of heat necessary to bring a given cathode type to the minimum emission temperature may be stated in terms of time, current and a constant which is determined by the physical properties of that given cathode type.

This relationship may be expressed by the following equation:

$$t_e = \frac{a}{(i_k^2 - i_m^2)}$$

where

t_e = Time to emission (seconds) = $>$ 0·4s*;

a = Constant for specific cathode type;

i_k = Minimum effective heating current necessary to time t_e (A); and

i_m = Absolute minimum value of effective heating current (A) to achieve emission if application time is of a sufficiently long duration (for example, $\geqslant$ 30 s from cold).

The values of constant a and the absolute minimum current (i_m) are given on each relevant lamp data sheet, together with the value of the cathode substitution resistor.

The minimum value of effective heating current (i_k) may be calculated by substituting the measured value of t_e into the equation given on each lamp data sheet.

Maximum Value of Effective Heating Current

Empirical evidence has shown that a relatively high effective heating current may be applied for a short time ($\leqslant$ 0·4 s) without cathode damage occurring, but that this high level of current shall be progressively reduced for times greater than 0·4 s, until at 2·0 s and longer the level should not exceed a value which is significantly different from those values already established for 50 Hz glow starter circuit practice.

Maximum levels of effective heating current are given on relevant lamp data sheet together with the value of substitution resistor required for the test.

A schematic representation of these requirements is given in Fig. 8.

D-5.1.1.2 *Open circuit voltages and transition time* (t_s)

The data in the relevant lamp data sheets is given for systems that require the use of a starting aid for systems that do not require a starting aid.

It is essential that the correct system is identified before testing comments.

When open circuit voltages are elevated at time t_e, the transition time (t_e) shall be kept below 100 ms if cathode heating is terminated at time t_e. Transition time of greater than 100 ms are acceptable provided cathode are kept at emission during the transition time.

As the lamp cathodes shall have been brought to emission during time t_e, it is only necessary to ensure that the effective heating current does not fall below the absolute minimum value (i_m) during the transition (lamp) starting phase.

The maximum value of open circuit voltage prior to time t_e being reached, and the minimum value of open circuit voltage after t_e is reached are specified on the relevant lamp data sheets.

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* Emission times less than 0·4 s are normally not acceptable because experience has shown that satisfactory cathode preheating is not always achievable in practice.

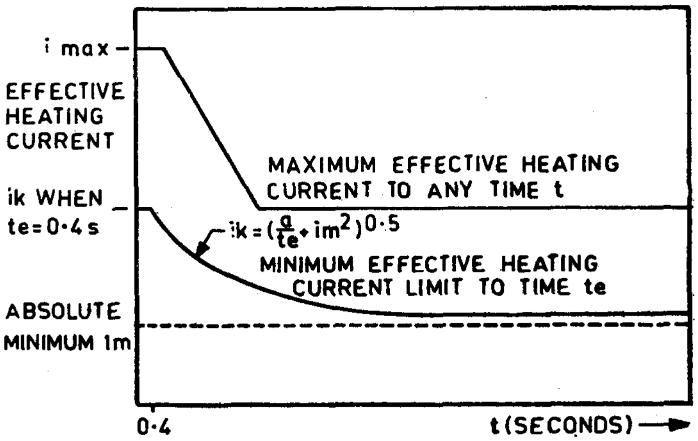

FIG. 8 CATHODE HEATING CURRENT REQUIREMENTS FOR CURRENT CONTROLLED BALLASTS

For some lamp types, the relevant lamp data sheets specify values of maximum open circuit voltage prior to time t_e being reached which are higher than, or the same as, the minimum values of open circuit voltage specified after time t_e has been reached. Ballast designed for these lamp types do not necessarily have to elevate the open circuit voltage to start these lamps correctly.

A schematic representation of these requirements is given in Fig. 2.

D-5.1.2 *Baltast Using Voltage Controlled Preheating*

D-5.1.2.1 *rms voltage and application time*

Although the control of current is the fundamental method of controlling cathode preheating conditions, the voltage method is simple to specify and easy to measure.

For the voltage control method appropriate cathode voltages, but to achieve emission temperature and to avoid excessive temperature may be determined empirically.

It has been shown that the emission temperature of a cathode occurs when cathode voltage levels exceed the following and are applied for a minimum time of 0·4 s:

a) Low resistance cathodes : 3·0 V rms, and
b) High resistance cathodes : 6·0 V rms.

To avoid excessive cathode temperature, other limits are imposed.

Transverse arcing occurs across all cathodes when the applied voltage exceeds 10 V rms and for low resistance cathodes a limit on the maximum applied voltage has been determined experimentally in relation to other lamp performance criteria. This limiting value is usually set below the transverse arcing level, but it is permissible to allow transverse arcing if precautions are taken to ensure that excessive currents do not flow in the cathode heating circuits which shall damage the cathode or ballast.

There are different lamp operating modes for lamps using low resistance cathodes. It is permissible to use a value of preheating cathodes voltage which is maintained during lamp operation, however, alternative systems may reduce this voltage after lamp starting.

Data which cover all of these requirements, are given on the relevant lamp data sheets.

D-5.1.2.2 *Open circuit voltages*

If the value of the lamp open circuit voltage, before the time of cathode thermal emission is reached, is lower than the value where cold starting is possible, then simultaneous application of cathode preheat and lamp voltage is allowable. Although electronic ballast circuits may offer several voltage control options, the principle of keeping lamp voltage below the cold starting level until thermal emission is achieved still applies.

For these ballasts only the maximum and minimum values of open circuit voltage shall be observed. These values are shown on the relevant lamp data sheet under 'Pre-starting conditions — voltage preheating of cathodes'.

For ballasts where open circuit voltages are elevated after cathode emission is attained, the values of open circuit voltage shown on the relevant data sheet under 'Pre-starting condition — Current preheating of cathodes' shall be observed. In this case t_e has been taken as 0·4 s.

Starting by this method usually requires the presence of an electrical earth (grounds) plane, the starting aid for all lamps except the internal starting aid lamps. A minimum value of peak voltage (V_p) shall be developed between the cathode and the starting aid as well as the necessary voltage across the lamp (V_a). Circuit operating frequency affects these voltage values as increasing frequency lowers the V_p requirement and increases the V_a requirement in most cases. Use of an internal conductive coating on the lamp may significantly increase the V_a value at high frequency. The proximity of the external starting aid distance increases starting voltage requirements. A minimum starting aid distance should be observed to avoid high starting aid currents.

D-5.2 Non-preheat Starting

D-5.2.1 Open circuit voltage measurement alone does not necessarily ensure that a ballast shall start a lamp cleanly and with the required minimal glow current period. Some ballasts are initially unable to supply the current necessary to drive the lamp quickly through the glow state and into the arc state.

D-5.2.2 To avoid this situation, a ballast impedance test is made with a lamp substitution resistors.

D-5.2.3 Values of lamp substitution resistor and the minimum current level which shall be obtained in this resistor are shown on the relevant lamp data sheet.

D-6 MEASUREMENT REQUIREMENTS

D-6.1 As the present and starting characteristics of electronic ballasts do not necessarily provide steady state voltages and currents, it is necessary to apply measuring devices and techniques which shall cope with these conditions.

D-6.2 The term 'effective heating current' has been used to describe the heating effect to time t which should result from a varying current and which is equivalent to a steady state rms current of the same heating effect (*see* Fig. 1).

D-6.3 Specialized measuring equipment is now readily available which shall give instant read-out of the required information, or more conventional equipment may be used together with manual computation of the data.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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IS 13021 (Part 2) : 1991 AC SUPPLIED ELECTRONIC BALLASTS FOR TUBULAR FLUORESCENT LAMPS — SPECIFICATION

PART 2 PERFORMANCE REQUIREMENTS

(*Page* 10, *Fig*. 5) — Substitute 'Z_2' *for* 'Z_1' against the impedance shown for generator circuit.

(ETD 23)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 APRIL 1994
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IS 13021 (Part 2) : 1991 ac SUPPLIED ELECTRONIC BALLASTS FOR TUBULAR FLUORESCENT LAMPS — SPECIFICATION

PART 2 PERFORMANCE REQUIREMENTS

(*Second* cover page, Foreword, para 1) — Insert the following addtional paras after para 1:

'The ballasts covered under this standard are intended to operate lamps at various frequencies including high frequencies. Attention is drawn to the fact that operating frequencies below 20 kHz may cause audio noise disturbances, whereas frequencies above 50 kHz may increase radio interference problems.

Some lamps may be specifically designed for high frequency operation on high frequency ballasts. The starting modes, preheat and non preheat are described.

> NOTE - The possibility exists for operation of lamps designed for perfect starting on circuits of the non preheat type. Lamps specified for operation on both types of circuits may appear in IS 2418 (Part 1):1977 and IS 2418(Part 2):1977 or lamp manufacturer will have to authorize such operation of their lamps.

In order to obtain satisfactory performance of fluorescent lamps and electronic ballast, it is necessary that certain features of their design be properly coordinated. It is essential, therefore, that specifications for these be written in terms of measurement made against some common baseline of reference, which must be reasonable, permanent and reproducible.

These conditions may be fulfilled by reference ballasts. Moreover the testing of ballasts for fluorescent lamps will, in general, be made with reference lamps, and in particular, by comparing results obtained on such lamps with ballasts to be tested and with a reference ballast.

Whereas the reference ballast for frequencies of 50 Hz is a self inductive coil, the high frequency reference ballast is a resistor because of the impedance of frequency and the back of influence of parasitic capacitance.'

(*Page* 1, *clause* **2.1**) — Inset the following at the end:

IS No.	*Title*
10321 (Part 1):1991	ac Supplied electronic ballast for tubular fluorescent lamps: Part 1 general and safety requirements

[*Page* 2, *clause* **5.2** (a) *line* 2]—Substitute 'or' *for* 'of'.

(*Page* 2, *clause* **6**, *Title*) — Replace the title with 'General Requirem in place of 'General Statement'.

(*Page* 5, *clause* **7.3.1**, *para* 1) — Insert the following para after the first para.

'For lamps not covered by IS 2418 (Part 2) :1977, the peak value of open circuit voltage shall not exceed 700 V.'

(*Page* 5, *clause* **7.3.2**, *para* 1) — Insert the following para at the end:

'For lamps not covered by IS 2418 (Part 2) :1977, the value of substitution resistor declared by the manufacturer shall be used.'

(*Page* 5, *clause* **7.3.3.1**) — Insert the following at the end:

'For lamps not covered by IS 2418(Part 2) :1977, the value of substitution resistor declared by the manufacturer shall be used.'

(*Page* 5, *clause* **7.3.3.1**, *line* 6, *formula*) — Substitute 'R_i' *for* 'R_o'.

(*Page* 7, *clause* **15.1**, *Informal Table*) — Insert the following note in this table at the end:

'In case of equipment schaffners NSG 223 A the rise time for slow high energy transient type/level may be taken as 500 ns for ASY 3 000 V and 100 ns for SYM 1 000 V.'

(*Page* 7, *clause* **16.2**) — Insert the following para at the end.

'For lamps not covered by IS 2418 (Part 2) :1977, the value of dummy cathode resistor declared by the manufacturer shall be used.'

(*Page* 8, *clause* **17.2.1**) — Insert the following new clause after this clause:

'18 SAFETY REQUIREMENTS

18.1 The ballast shall meet the safety requirements as given in **7** to **19** of IS 13021 (Part 1) : 1991.'

(ETD 23)

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